



Work Area: SMM
Work Type: I&M
Originator Company: GEOCISA UK

C435 Farringdon Main Station

CRL Lead reviewer: [REDACTED]
CRL Reviewer: [REDACTED]

Monitoring Close-Out Report and Final Report: EDF Cable Tunnel at Farringdon Station

CRL Document Number: C435-BFK-C2-RGN-M123-51584

Supplier Document Number: N/A

Contract MDL reference C13.012

1. Contractor Document Submittal History:

Revision:	Date:	Prepared by:	Checked by:	Approved by:	Reason for Issue:
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2.0	20-07-15	[REDACTED]	[REDACTED]	[REDACTED]	For acceptance
3.0	29-09-15	[REDACTED]	[REDACTED]	[REDACTED]	For acceptance

2a. Stakeholder Review Required? YES NO

Stakeholder submission required: LU NR DLR RfL LO Other: _____

Purpose of submission: For no objection For information

This document has been reviewed by the following individual for coordination, compliance, integration and acceptance and is acceptable for transmission to the above stakeholder for the above stated purpose.

Sign: _____ Role: _____ Name: _____ Date: _____

Sign: _____ Role: _____ Name: _____ Date: _____

2b. Review by Stakeholder (if required):

Stakeholder Organisation	Job Title	Name	Signature	Date	Acceptance
					<input type="checkbox"/>
					<input type="checkbox"/>
					<input type="checkbox"/>

compliance with their contractual obligations and does not constitute
ds or materials developed or selected by the designer/supplier.

3. Acceptance by Crossrail:

20/10/2015

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Learning Legacy Document

A. INTRODUCTION

In line with the C122 – M&W Specification KX10 – Instrumentation & Monitoring C122-OVE-Z4-RSP-CR001-00007, this close out report aims to address the following points in relation to the instrumentation defined in Section B.

- Identify movements observed by the relevant instruments;
- Relate these movements to construction activities, where applicable.
- Identify trigger breaches that may have occurred.
- Demonstrate that the rate of change of the data is either in line with the required rate or such that residual risks are minimal. In this case, the rates need to be calculate in relation to convergences.
- Identify any such residual risks should there be considered to be any.
- Based on the above points, this close out reports will provide justification for the decommissioning of the instruments.

B. INSTRUMENTS

B.1 Description of the Instruments

This Close-Out Report relates the EDF Cable Tunnel, consisting of 21No. 3D Targets read manually. See table 1 below with details.

PRISM CODE	LOCATION	COORDINATES	
		X	Y
C435-RP04901	EDF tunnel	82155.464	36598.87
C435-RP04902	EDF tunnel	82155.949	36598.913
C435-RP04903	EDF tunnel	82156.21	36598.869
C435-RP04904	EDF tunnel	82154.785	36564.949
C435-RP04905	EDF tunnel	82155.401	36564.984
C435-RP04906	EDF tunnel	82155.766	36564.975
C435-RP04907	EDF tunnel	82154.716	36552.696
C435-RP04908	EDF tunnel	82155.248	36552.694
C435-RP04909	EDF tunnel	82155.447	36552.729
C435-RP04910	EDF tunnel	82153.044	36534.948
C435-RP04911	EDF tunnel	82153.532	36534.827
C435-RP04912	EDF tunnel	82153.741	36534.814
C435-RP04913	EDF tunnel	82144.529	36513.72
C435-RP04914	EDF tunnel	82144.984	36513.402
C435-RP04915	EDF tunnel	82145.179	36513.359
C435-RP04916	EDF tunnel	82136.348	36502.914
C435-RP04917	EDF tunnel	82136.687	36502.497
C435-RP04918	EDF tunnel	82136.839	36502.452
C435-RP04919	EDF tunnel	82061.654	36455.815
C435-RP04920	EDF tunnel	82061.828	36455.516
C435-RP04921	EDF tunnel	82061.96	36455.375

Table 1: Details of 3D Targets installed inside EDF Cable Tunnel.

Note that prisms installed on Section 0 (C435-RP04901, C435-RP04902, C435-RP04903) and Section 6 (C435-RP04919, C435-RP04920, C435-RP04921) are installed outside any works influence area and used as reference points for the rest of prisms installed inside this utility.

These prisms read manually are shown in the following documents:

Drawings:

- C122-OVE-C2-DDA-CR001_Z-31537

Installation Reports:

- C435-BFK-C2-RGN-M123-50032

B.2 Location of the Instruments

As you can see from the Figure 1 below, the instruments described in Section B.1 are located in Farringdon Road area. A drawing showing the location of these devices can be found in the Appendix A.

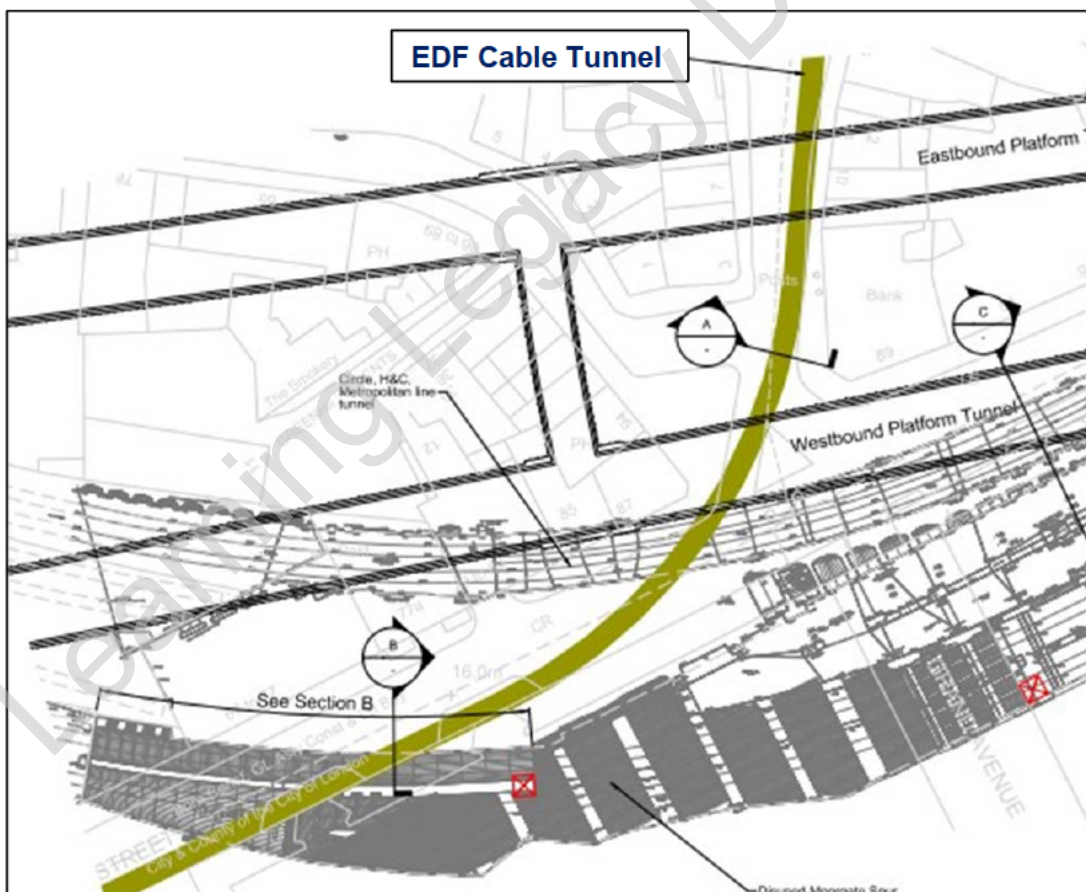


Figure 1 – Map showing the Location EDF Cable Tunnel.

C. MOVEMENTS

C.1 Movements Resulting from Construction Activities

C.1.1 Relevant Crossrail (BFK) Works

The construction activities associated with these instruments are related to Crossrail tunnelling works. In all cases, these comprise of the passage of a TBMs (C300) and a platform tunnel enlargement.

ACTIVITY	START DATE	END DATE
WB TBM passage	30/09/2013	04/10/2013
EB TBM passage	16/01/2014	20/01/2014
SCL PTW enlargement	28/06/2014	28/09/2014
SCL PTE enlargement	25/07/2014	09/11/2014
SCL CP4	17/09/2014	16/10/2014

C.1.2 Resulting Movements

- 3D Targets installed inside this utility located below Charterhouse and St. John Streets is shown in Appendix B.
- These 3D Targets were installed to control the C300 EB and WB TBM passages and posterior C435 SCL Enlargement of the platform tunnels, recording a maximum settlement of 34.10mm for these activities.

C.2 Trigger Breaches

The Instrumentation and Monitoring Plan: EDF Cable Tunnel at Farringdon Station C122-OVE-C2-RGN-M123-50015 outlines the triggers associated with the works as follow:

	Trigger values for asset protection (apply at all construction stages)		
	GREEN	AMBER	RED
Maximum differential settlement (mm)	46	57	71
Maximum differential displacement between the crown and the invert position (mm)	5	6	8

Also, a default alert value of 10mm (in any direction) is applied to all instrumentation associated with the EDF Cable Tunnel.

C435-BFK-C2-RGN-M123-51584

MONITORING GROUP (Location)	POINT ID	TYPE	DIRECTION	DATE OF LAST READING	LAST READING VALUE (mm)	TRIGGER LEVEL	
						WORST HISTORICAL STATUS	CURRENT STATUS
EDF TUNNEL	C435-RP04901	MANUAL PRISM	X	07/05/2015 12:00	0.00	Clear	Clear
	C435-RP04902	MANUAL PRISM	X	07/05/2015 12:00	0.00	Clear	Clear
	C435-RP04903	MANUAL PRISM	X	07/05/2015 12:00	0.00	Clear	Clear
	C435-RP04904	MANUAL PRISM	X	07/05/2015 12:00	-0.04	Clear	Clear
	C435-RP04905	MANUAL PRISM	X	07/05/2015 12:00	-1.54	Clear	Clear
	C435-RP04906	MANUAL PRISM	X	07/05/2015 12:00	-3.48	Clear	Clear
	C435-RP04907	MANUAL PRISM	X	07/05/2015 12:00	-1.37	Clear	Clear
	C435-RP04908	MANUAL PRISM	X	07/05/2015 12:00	-2.56	Clear	Clear
	C435-RP04909	MANUAL PRISM	X	07/05/2015 12:00	-4.01	Clear	Clear
	C435-RP04910	MANUAL PRISM	X	07/05/2015 12:00	-4.04	Clear	Clear
	C435-RP04911	MANUAL PRISM	X	07/05/2015 12:00	-5.65	Clear	Clear
	C435-RP04912	MANUAL PRISM	X	07/05/2015 12:00	-2.93	Clear	Clear
	C435-RP04913	MANUAL PRISM	X	07/05/2015 12:00	2.34	Clear	Clear
	C435-RP04914	MANUAL PRISM	X	07/05/2015 12:00	0.17	Clear	Clear
	C435-RP04915	MANUAL PRISM	X	07/05/2015 12:00	-1.44	Clear	Clear
	C435-RP04916	MANUAL PRISM	X	07/05/2015 12:00	-0.63	Clear	Clear
	C435-RP04917	MANUAL PRISM	X	07/05/2015 12:00	2.58	Clear	Clear
	C435-RP04918	MANUAL PRISM	X	07/05/2015 12:00	3.91	Clear	Clear
	C435-RP04919	MANUAL PRISM	X	07/05/2015 12:00	1.05	Clear	Clear
	C435-RP04920	MANUAL PRISM	X	07/05/2015 12:00	1.95	Clear	Clear
	C435-RP04921	MANUAL PRISM	X	07/05/2015 12:00	2.05	Clear	Clear

MONITORING GROUP (Location)	POINT ID	TYPE	DIRECTION	DATE OF LAST READING	LAST READING VALUE (mm)	TRIGGER LEVEL	
						WORST HISTORICAL STATUS	CURRENT STATUS
EDF TUNNEL	C435-RP04901	MANUAL PRISM	Y	07/05/2015 12:00	0.00	Clear	Clear
	C435-RP04902	MANUAL PRISM	Y	07/05/2015 12:00	0.00	Clear	Clear
	C435-RP04903	MANUAL PRISM	Y	07/05/2015 12:00	0.00	Clear	Clear
	C435-RP04904	MANUAL PRISM	Y	07/05/2015 12:00	-1.56	Clear	Clear
	C435-RP04905	MANUAL PRISM	Y	07/05/2015 12:00	0.46	Clear	Clear
	C435-RP04906	MANUAL PRISM	Y	07/05/2015 12:00	-1.98	Clear	Clear
	C435-RP04907	MANUAL PRISM	Y	07/05/2015 12:00	0.80	Clear	Clear
	C435-RP04908	MANUAL PRISM	Y	07/05/2015 12:00	2.65	Clear	Clear
	C435-RP04909	MANUAL PRISM	Y	07/05/2015 12:00	2.12	Clear	Clear
	C435-RP04910	MANUAL PRISM	Y	07/05/2015 12:00	3.76	Clear	Clear
	C435-RP04911	MANUAL PRISM	Y	07/05/2015 12:00	6.50	Default alert	Clear
	C435-RP04912	MANUAL PRISM	Y	07/05/2015 12:00	2.08	Clear	Clear
	C435-RP04913	MANUAL PRISM	Y	07/05/2015 12:00	-5.15	Clear	Clear
	C435-RP04914	MANUAL PRISM	Y	07/05/2015 12:00	-6.22	Clear	Clear
	C435-RP04915	MANUAL PRISM	Y	07/05/2015 12:00	-3.48	Clear	Clear
	C435-RP04916	MANUAL PRISM	Y	07/05/2015 12:00	-5.81	Clear	Clear
	C435-RP04917	MANUAL PRISM	Y	07/05/2015 12:00	-4.63	Clear	Clear
	C435-RP04918	MANUAL PRISM	Y	07/05/2015 12:00	-3.80	Clear	Clear
	C435-RP04919	MANUAL PRISM	Y	07/05/2015 12:00	0.00	Clear	Clear
	C435-RP04920	MANUAL PRISM	Y	07/05/2015 12:00	0.00	Clear	Clear
	C435-RP04921	MANUAL PRISM	Y	07/05/2015 12:00	0.00	Clear	Clear

MONITORING GROUP (Location)	POINT ID	TYPE	DIRECTION	DATE OF LAST READING	LAST READING VALUE (mm)	TRIGGER LEVEL	
						WORST HISTORICAL STATUS	CURRENT STATUS
EDF TUNNEL	C435-RP04901	MANUAL PRISM	Z	07/05/2015 12:00	0	Clear	Clear
	C435-RP04902	MANUAL PRISM	Z	07/05/2015 12:00	0	Clear	Clear
	C435-RP04903	MANUAL PRISM	Z	07/05/2015 12:00	0	Clear	Clear
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	C435-RP04906	MANUAL PRISM	Z	07/05/2015 12:00	-34.1	Default alert	Default alert
	C435-RP04907	MANUAL PRISM	Z	07/05/2015 12:00	-26.23	Default alert	Default alert
	C435-RP04908	MANUAL PRISM	Z	07/05/2015 12:00	-27.12	Default alert	Default alert
	C435-RP04909	MANUAL PRISM	Z	07/05/2015 12:00	-26.06	Default alert	Default alert
	C435-RP04910	MANUAL PRISM	Z	07/05/2015 12:00	-20.87	Default alert	Default alert
	C435-RP04911	MANUAL PRISM	Z	07/05/2015 12:00	-25.78	Default alert	Default alert
	C435-RP04912	MANUAL PRISM	Z	07/05/2015 12:00	-26.76	Default alert	Default alert
	C435-RP04913	MANUAL PRISM	Z	07/05/2015 12:00	-20.94	Default alert	Default alert
	C435-RP04914	MANUAL PRISM	Z	07/05/2015 12:00	-17.83	Default alert	Default alert
	C435-RP04915	MANUAL PRISM	Z	07/05/2015 12:00	-17.84	Default alert	Default alert
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	C435-RP04918	MANUAL PRISM	Z	07/05/2015 12:00	-4.86	Clear	Clear
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	C435-RP04920	MANUAL PRISM	Z	07/05/2015 12:00	0	Clear	Clear
C435-RP04921	MANUAL PRISM	Z	07/05/2015 12:00	0	Clear	Clear	

C.3 Significant Issues with the Instrumentation

- No issues

The rates of residual settlement direction for these 3D Targets have been determined and in all cases these rates are less than 2mm/year.

D. CONCLUSIONS

Following the C300 WB and EB TBMs passage, as well as the SCL enlargement of PTE and PTW and the excavation of CP4 cross passage, the maximum measured settlement and horizontal movement in X and Y directions for these 3D Targets remain less than the expected.

After the works, all devices do not show any significant movement, therefore these devices are considered stabilized.



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Appendix A: Drawings / Photomontages



LEGEND

	BRE Levelling Stud		Water Settlement Cells
	Vibrating Wire Crackmeter		Electro level
	Calibrated Tell-Tale		
	Bi-axial Tiltmeter		
	3D Geodetic Prisms		

Rev.	Date	Description	By	Chkd	App	Auth
18092084						

Contract : C435-BR-FURBIMONIC STATION		Scale : @ A3	
Originator : GEOCISA		3D MANUAL PRISMS	
Location : CIUDAD REAL GENERAL		Rev. : 04/2014	
Title :		Auth. : 04/2014	

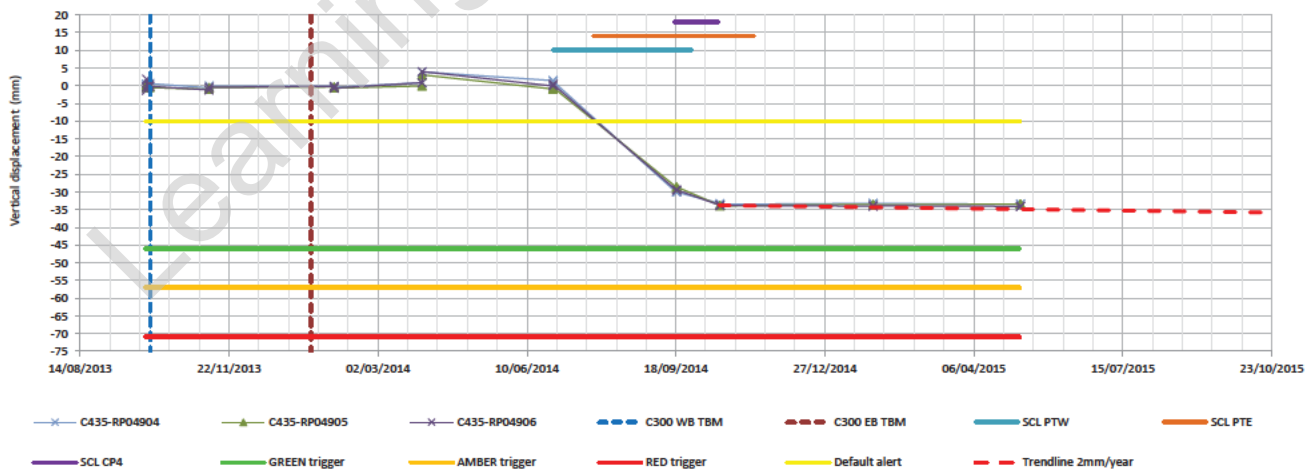
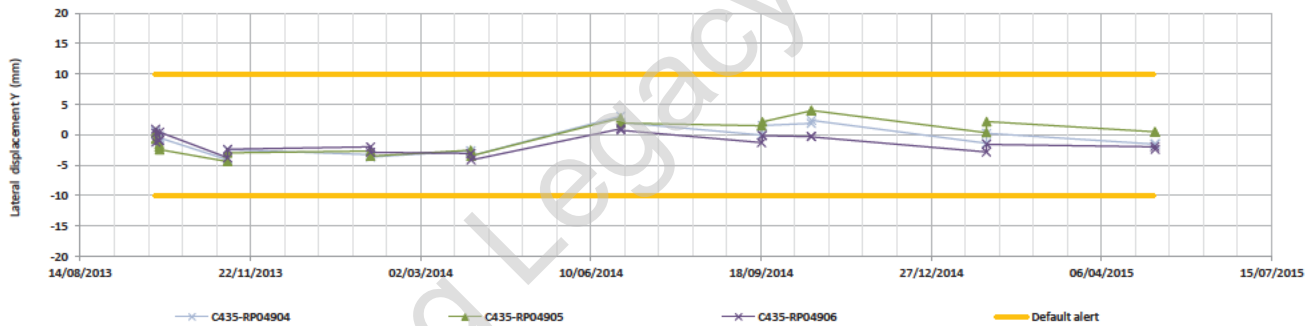
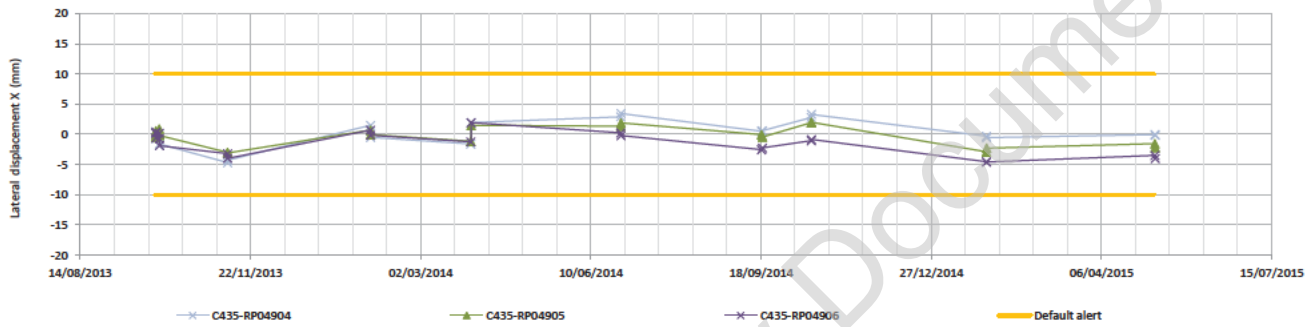
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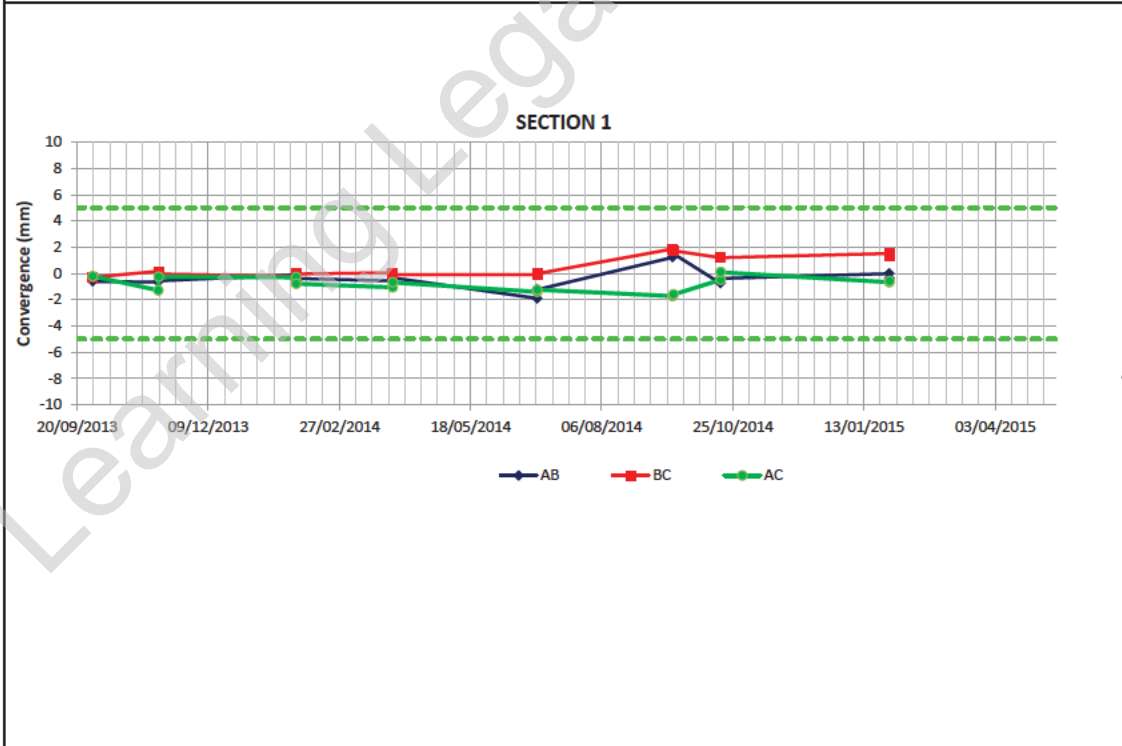
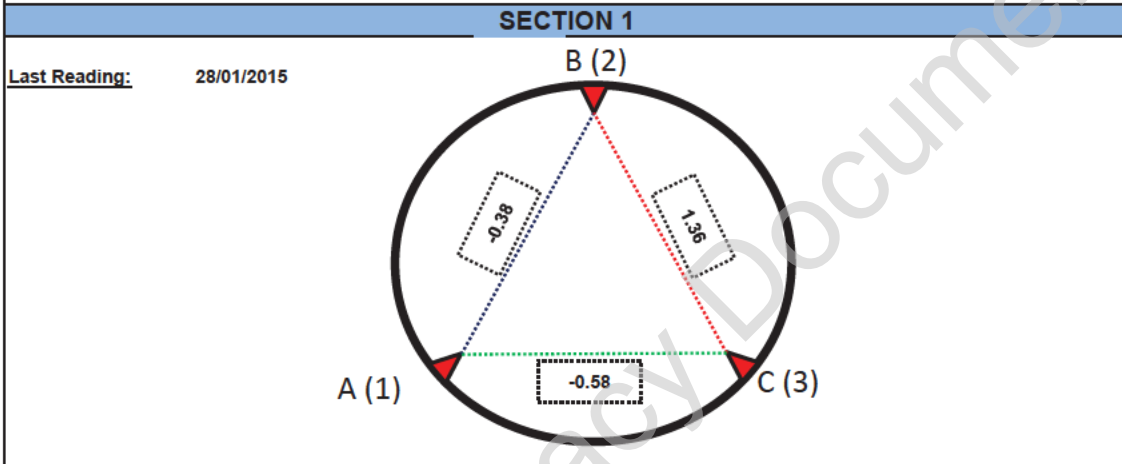
Appendix B: Graphs

REPORT: Time plot manual readings
AREA: EDF Tunnel
DEVICE: 3D Monitoring Targets



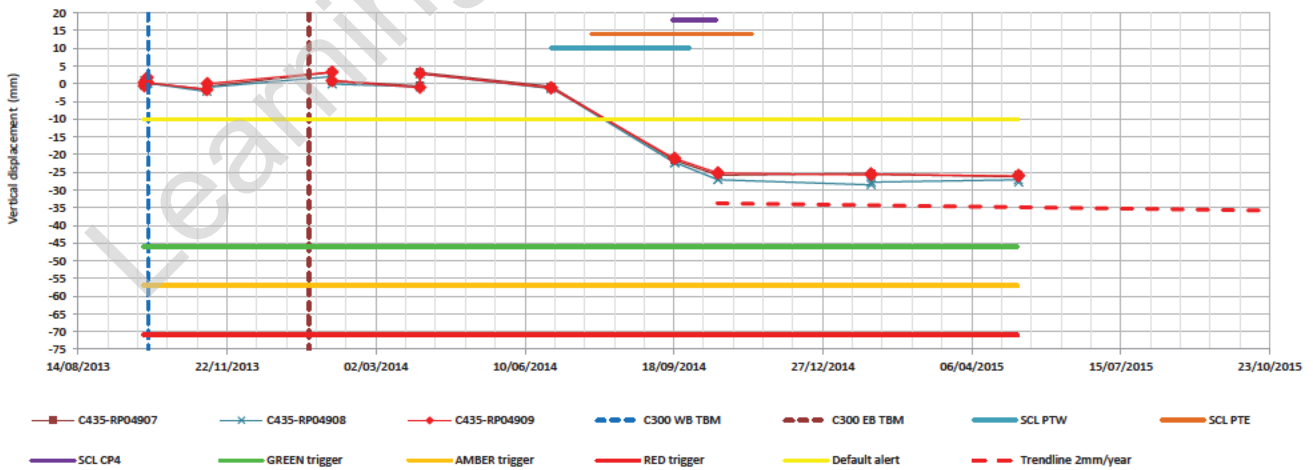
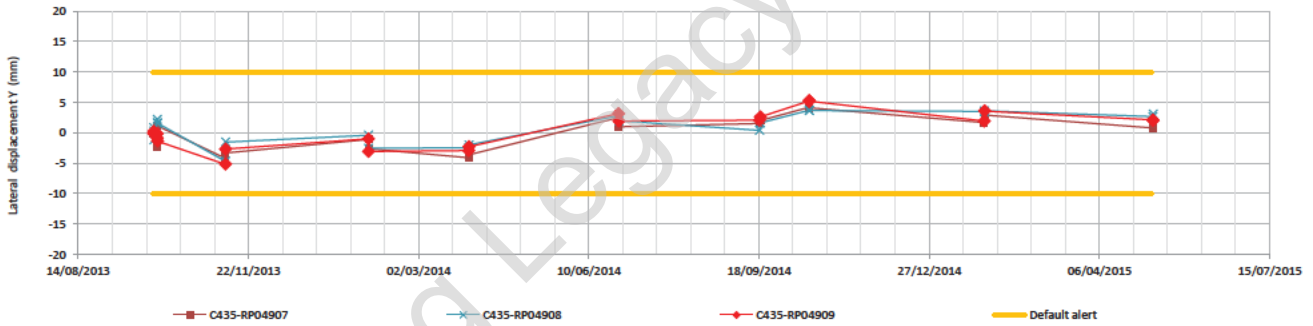
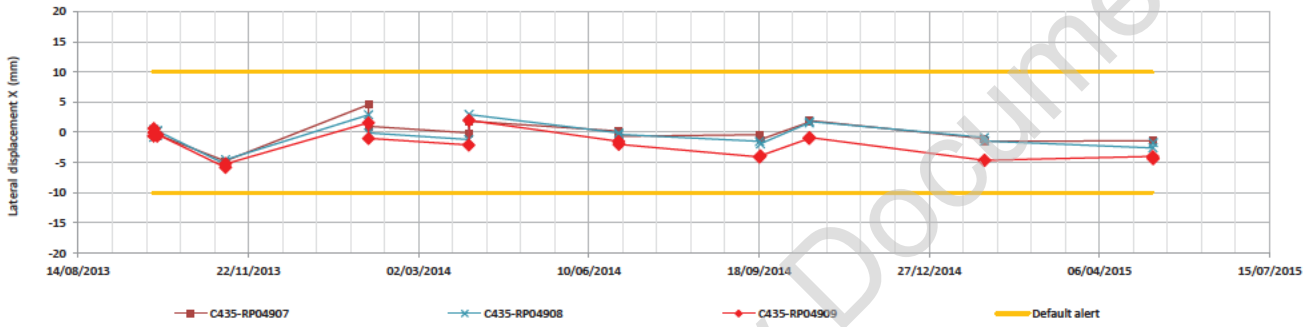
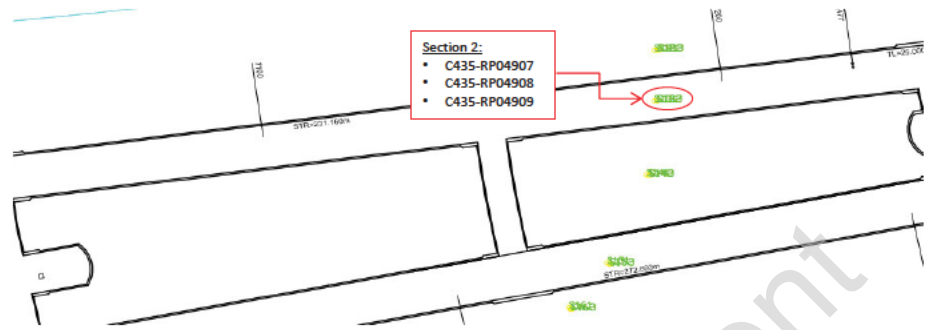
REMARKS:

REPORT: CONVERGENCES
 AREA: EDF TUNNEL
 DEVICE: Manual 3D prisms



Remarks:
 Positive values

REPORT: Time plot manual readings
AREA: EDF Tunnel
DEVICE: 3D Monitoring Targets



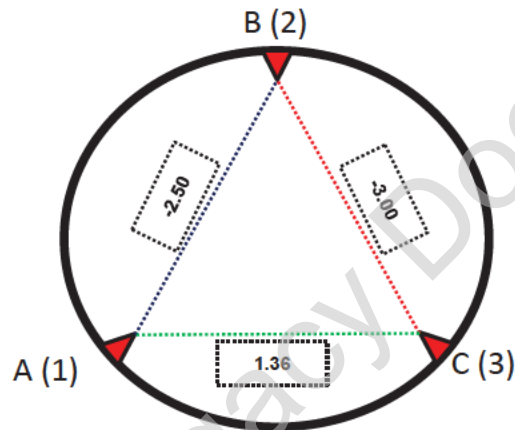
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 DEVICE: Manual 3D prisms

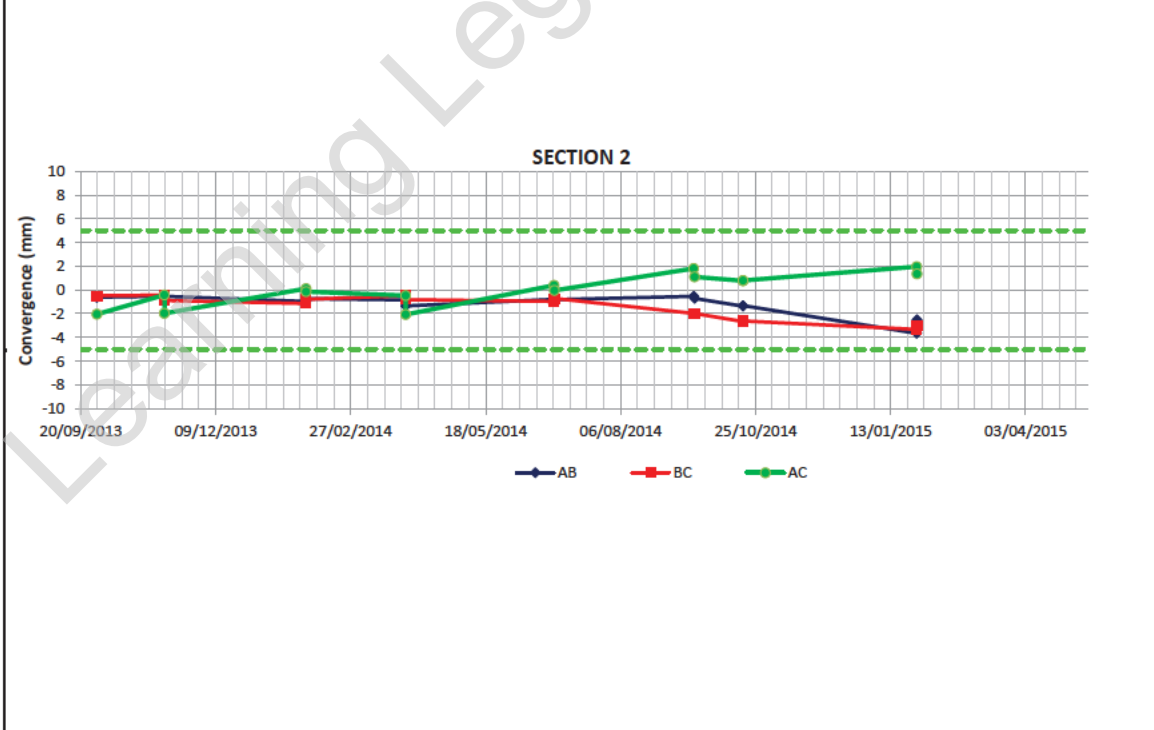


SECTION 2

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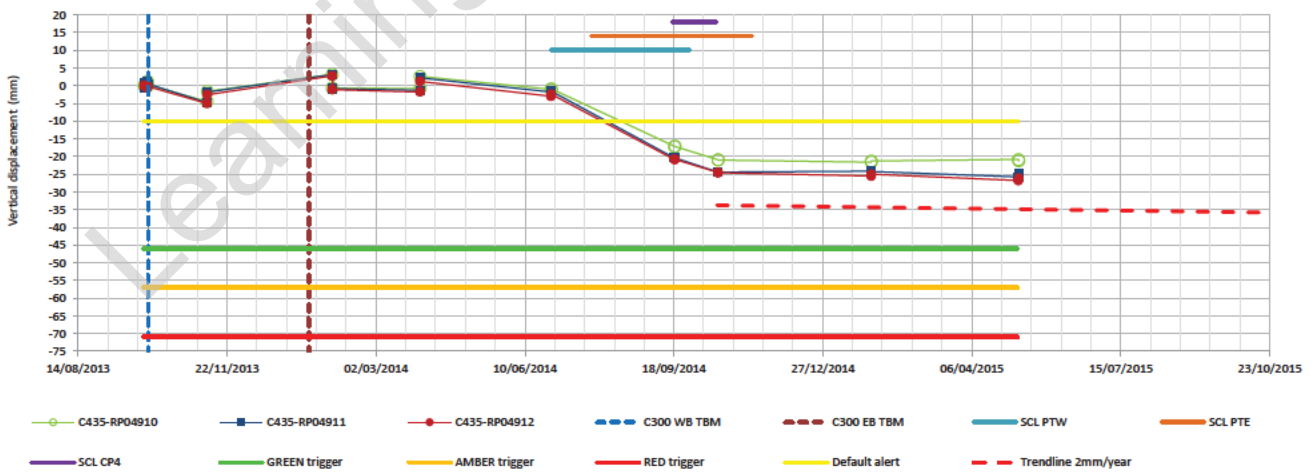
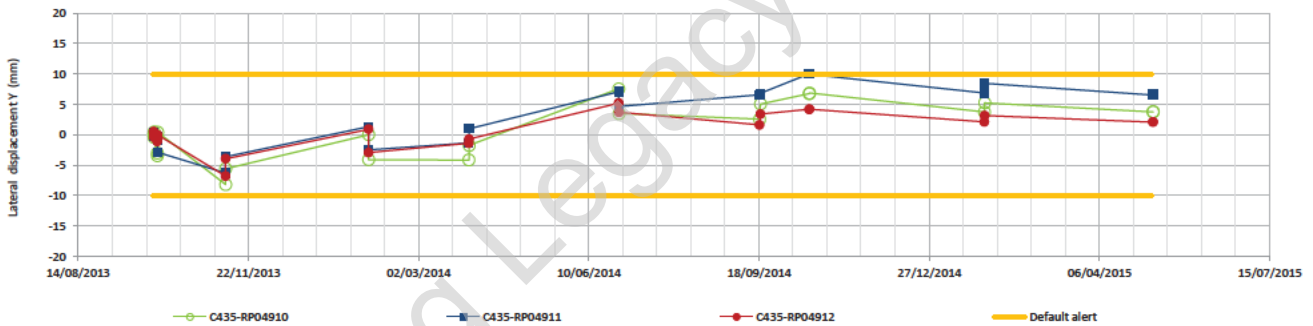
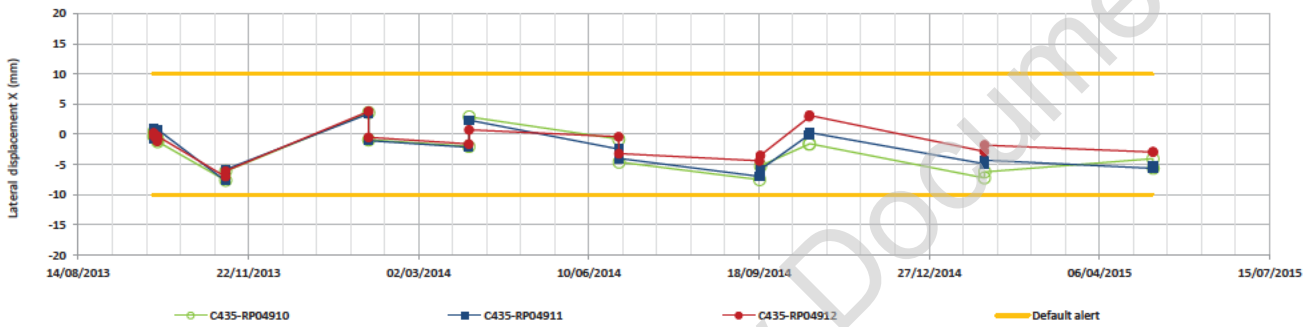


SECTION 2



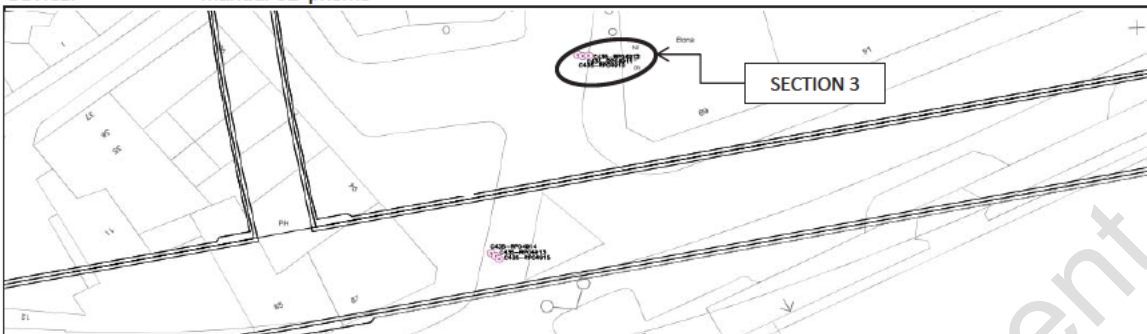
Remarks:
 Positive values

REPORT: Time plot manual readings
AREA: EDF Tunnel
DEVICE: 3D Monitoring Targets

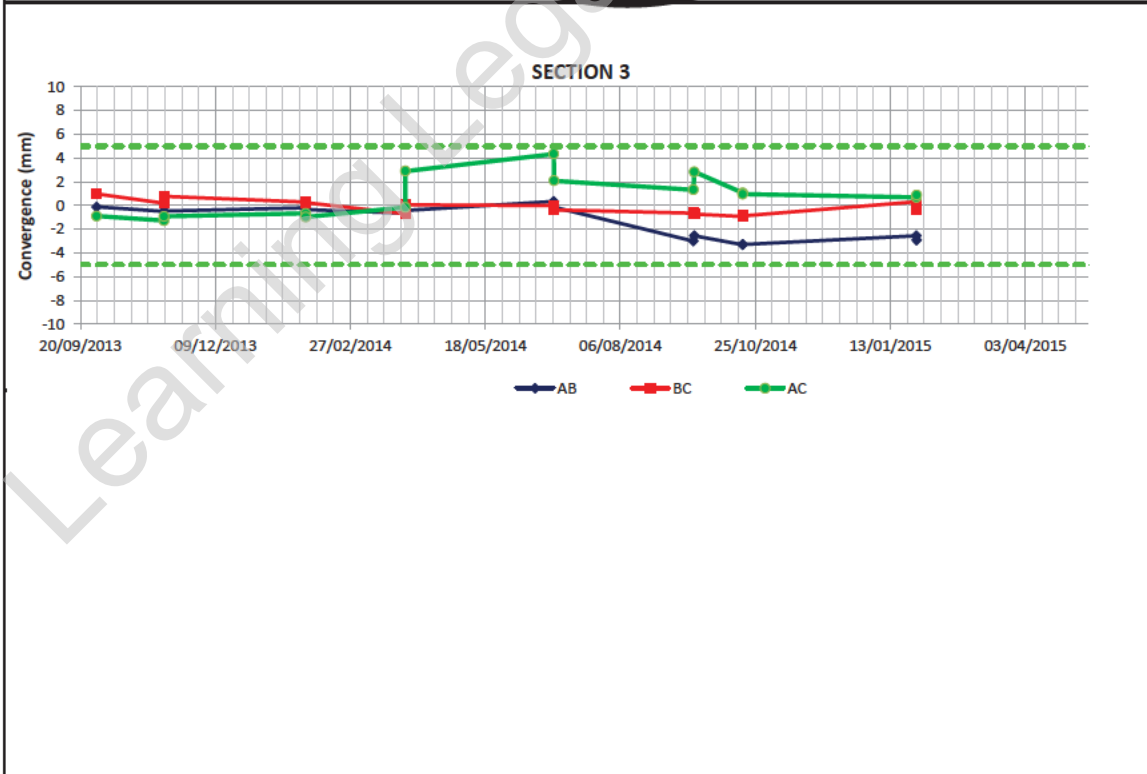
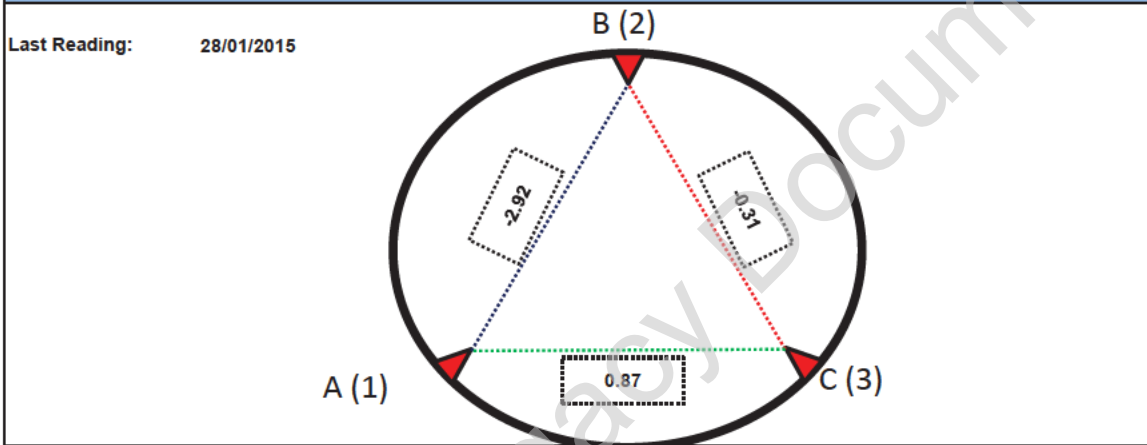


REMARKS:

REPORT: CONVERGENCES
 AREA: EDF TUNNEL
 DEVICE: Manual 3D prisms



SECTION 3

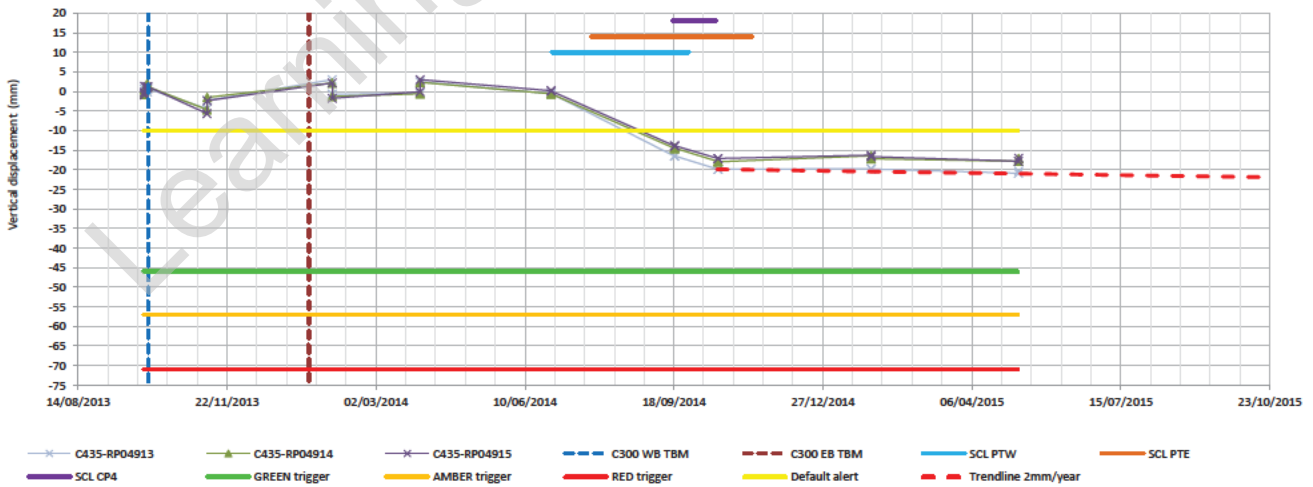
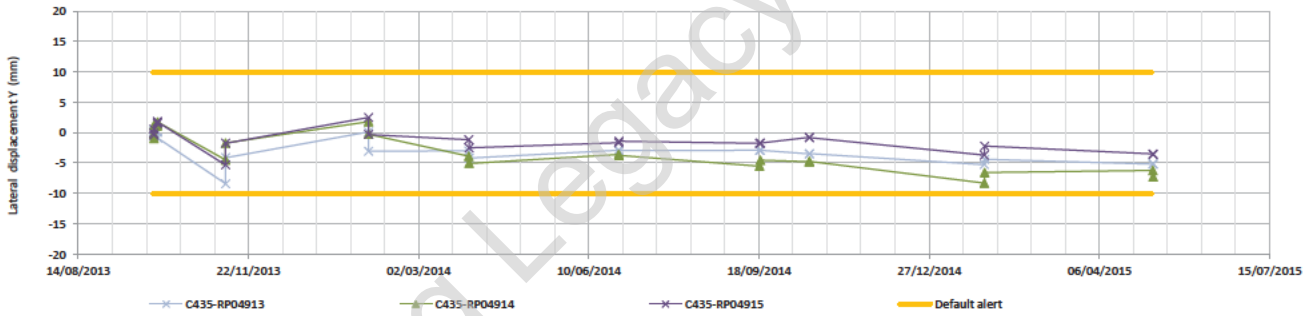
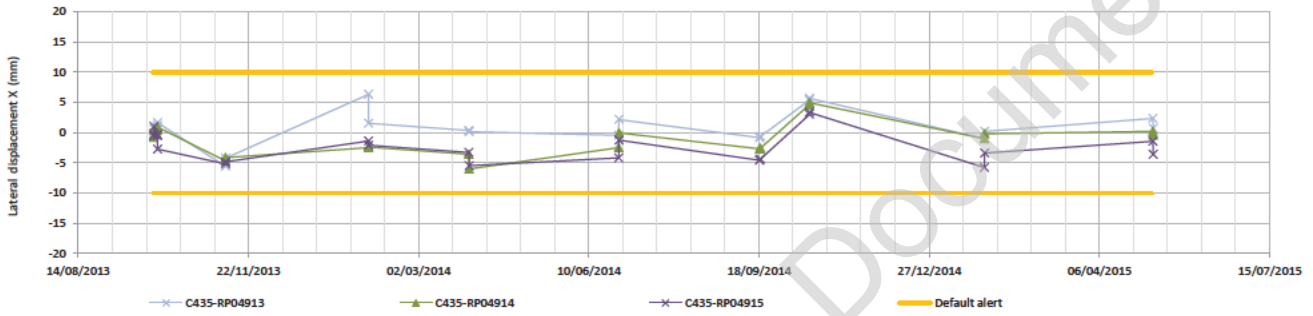


Remarks:
 31-03-13 and 27-06-14 show bad readings on X and Y direction during the second set-up.

REPORT: Time plot manual readings
 AREA: EDF Tunnel
 DEVICE: 3D Monitoring Targets

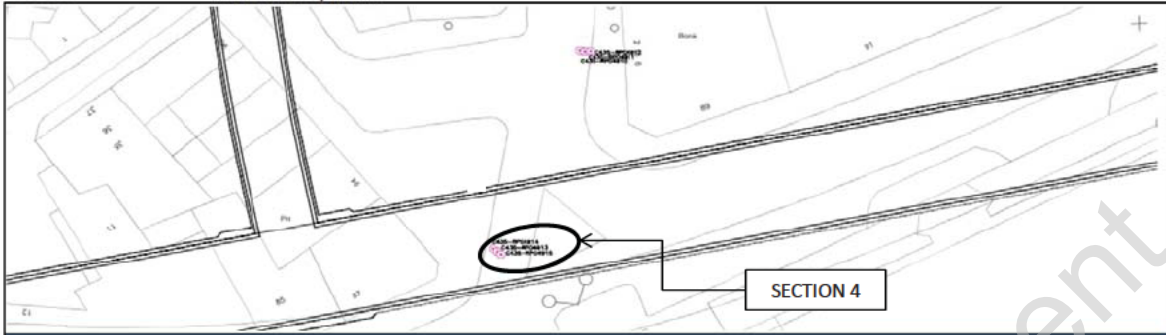


Section 4:
 • C435-RP04913
 • C435-RP04914
 • C435-RP04915



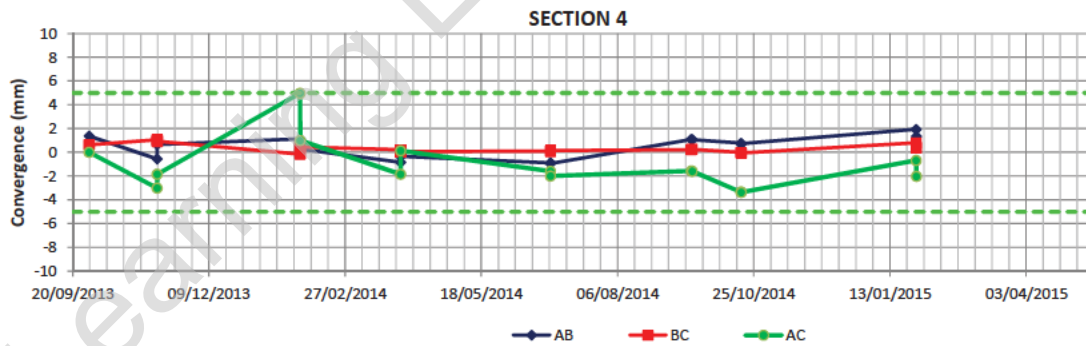
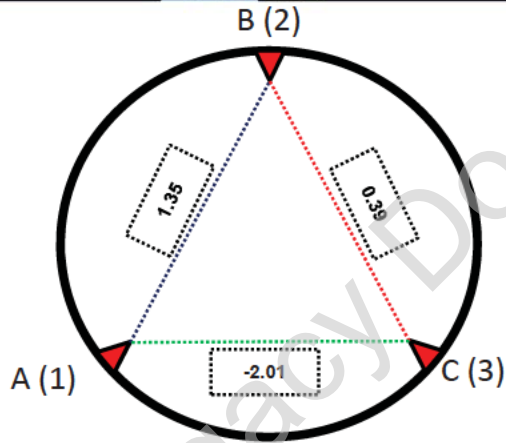
REMARKS:

REPORT: CONVERGENCES
 AREA: EDF TUNNEL
 DEVICE: Manual 3D prisms



SECTION 4

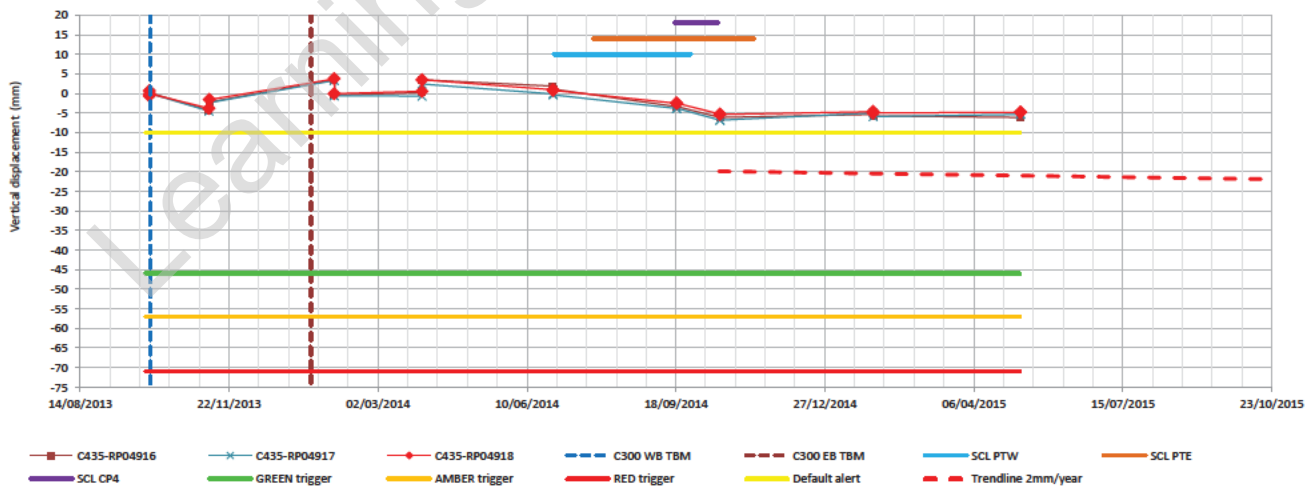
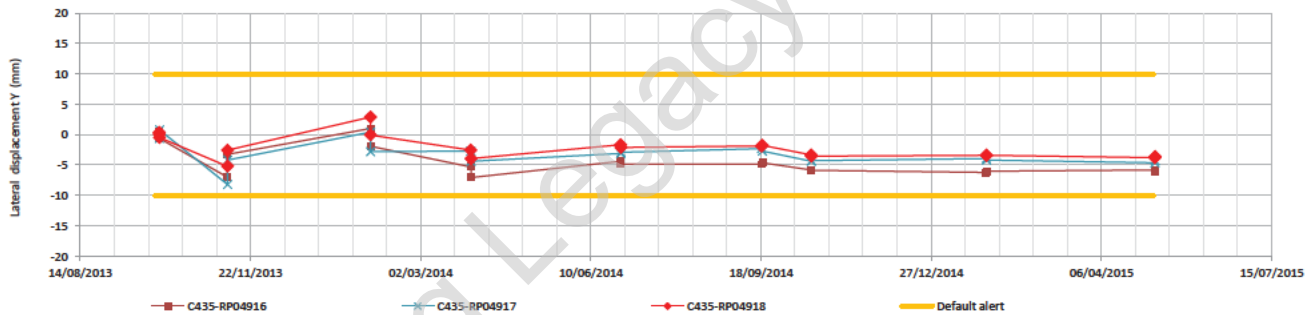
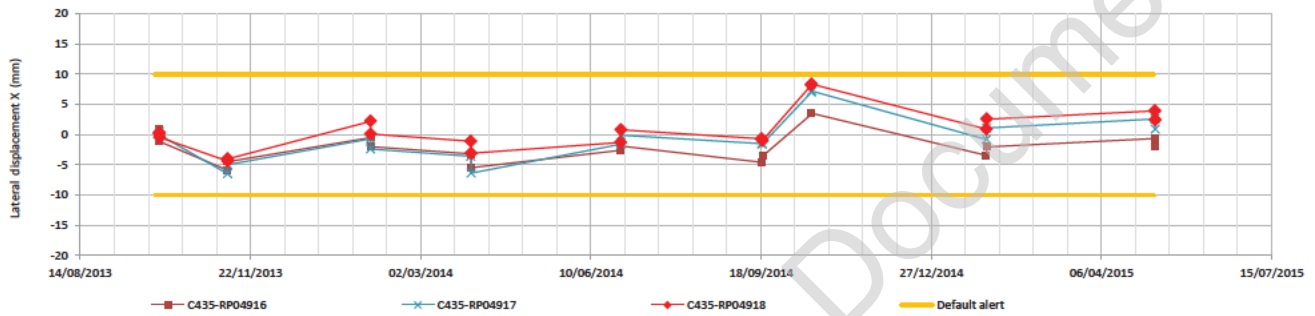
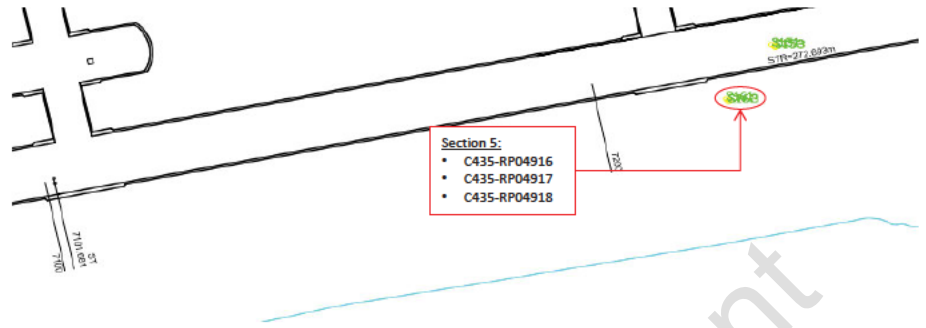
Last Reading: 28/01/2015



Remarks:

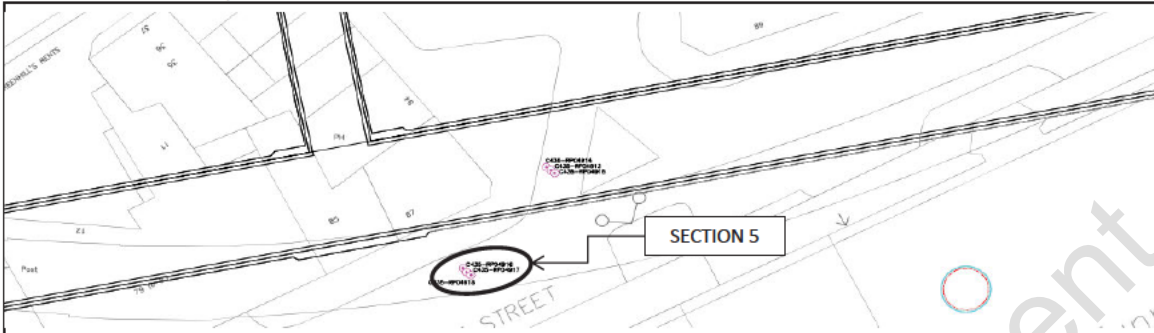
31/01/2014 Bad reading in the first set-up.

REPORT: Time plot manual readings
 AREA: EDF Tunnel
 DEVICE: 3D Monitoring Targets



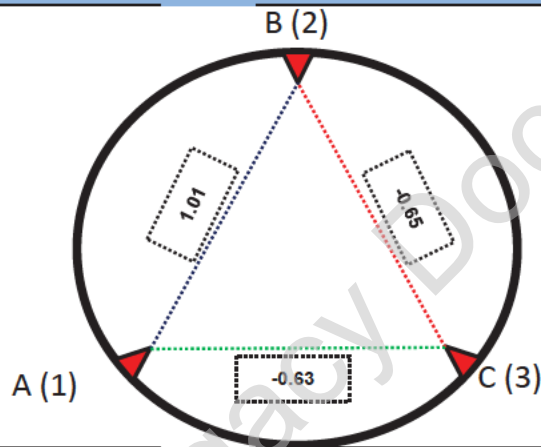
REMARKS:

REPORT: CONVERGENCES
 AREA: FLEET SEWER
 DEVICE: Tape Extensometer

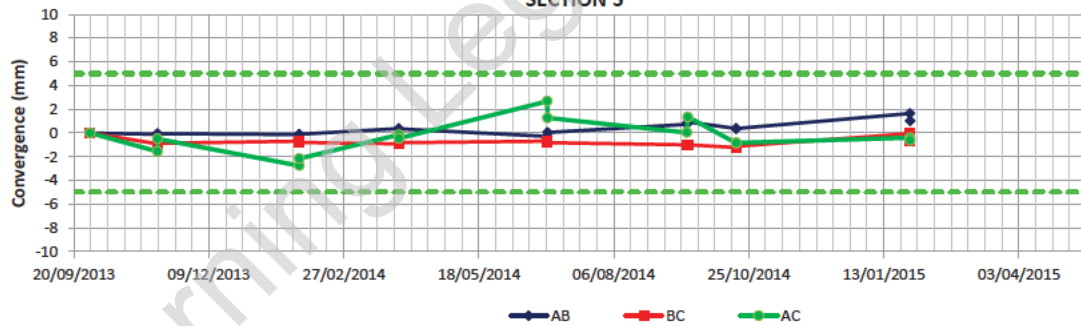


SECTION 5

Last Reading: 28/01/2015

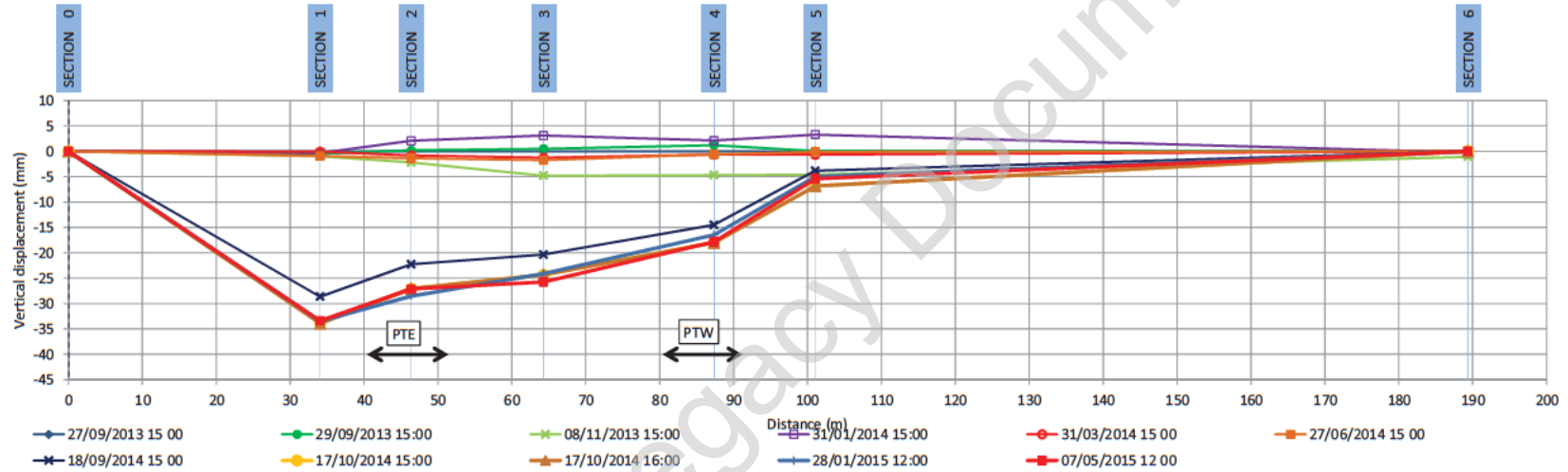


SECTION 5



Remarks:

REPORT: Levelling Diagram profile EDF Tunnel.
 AREA: EDF Tunnel
 DEVICE: 3D Monitoring prisms



REMARKS:

Section 0 and Section 6 are Reference sections.

